Artificial Reef Deployment with Community Participation: A Pathway to Sustainable Livelihoods and Socio-Economic Upliftment of Traditional Fishers – A Study

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ABSTRACT

This paper explores various methods employed and experiences gained in the fabrication, deployment, and monitoring of artificial reefs along the east coast of Tamil Nadu by governmental and non-governmental organizations. The community participatory method has proven to be the most effective in yielding positive outcomes for both the fishing community and the environment. This approach enhances biodiversity, ensures better livelihoods, and promotes biological resource enrichment, particularly in fishery resources. The involvement of fisher communities along the Tamil Nadu coast in the establishment and utilization of artificial reefs is discussed. It is strongly recommended that community participation be ensured to achieve optimal results in artificial reef projects.

1. Introduction

Food security and nutritional standards are two key priorities emphasized in the developmental plans of most developing countries. The current agricultural land is insufficient to meet the growing food demand due to constraints on cultivable land for crops, cattle, and poultry. As a result, we must increasingly rely on marine resources, as the ocean's production potential is three-dimensional and can be significantly enhanced through conservation, resource management, and mariculture.

The biological productivity in coastal waters is twelve times higher than that of deep-sea waters due to sunlight penetration, which promotes primary production. This, in turn, triggers better secondary and tertiary production, particularly in fishery resources. Hence, nearshore waters serve as breeding, feeding, and nursery grounds for numerous species, leading to high species abundance and diversity.

India's marine fish production has increased from a mere 0.38 million tonnes in 1950 to 3.2 million tonnes in 2008, but it has stagnated at around 3 million tonnes in recent years due to overfishing in inshore waters. The estimated potential yield of 2.2 million tonnes from inshore waters has already been reached, with nearly 90% of fishing efforts concentrated in these zones.

Additionally, inshore waters face severe degradation due to developmental activities, pollution, intensive bottom trawling, and unsustainable fishing practices. The absence of proper management and conservation measures has led to the depletion of fish stocks, posing a risk to food security. To address this, efforts have been made to improve indigenous artificial reef technology, known as "Mullam," by enhancing its durability and ecosystem services. This adaptation serves not only as a biodiversity enhancement tool but also as a means to improve the socio-economic conditions of traditional coastal fishers. One such initiative by the PLANT Trust is the deployment of artificial reefs to restore coastal ecosystems, increase biodiversity, and enhance fishery resources through community participation.

2. Traditional Artificial Reefs and Indigenous Knowledge (ITK)

Traditionally, artificial reefs were designed to attract and concentrate fish at specific locations for seasonal harvesting. Fishers used entire trees or bundled branches weighted with stones as anchors in shallow

waters, attracting fish due to the biodegradation of leaves and bark. However, these reefs were temporary and often displaced by mechanized bottom trawlers, necessitating costly seasonal reconstruction.

3. Modern Artificial Reef Concept

Modern artificial reefs are constructed using reinforced concrete in various shapes to accommodate different fish species. These structures increase the availability of hard substrata on the seafloor, promoting the settlement of benthic flora and fauna. The resulting ecosystem provides food, shelter, and breeding grounds for fish, enhancing population growth and ensuring a sustainable fishery for artisanal fishers.

4. Institution Building

To ensure long-term sustainability, selected fishing villages are introduced to artificial reef technology through video presentations and workshops. Fishers are encouraged to form and register an "Artificial Reef Fabrication, Deployment & Monitoring Committee" under the Societies Act. This committee, comprising expert fishers and community leaders, serves as the governing body for reef establishment and utilization.

5. Community Participation and Ownership

After forming the expert committee, a Memorandum of Understanding (MoU) is signed, designating the artificial reef as village property. The committee assumes responsibility for fabrication, deployment, and monitoring, with technical and financial support provided by various funding agencies such as Ministry of Forest and Environment and Climate Change, Government of India, UNDP, GEF, SGP, Madras Atomic Power Station CSR project fund and Consulate General of Australia, Chennai through an implementing agency, the NGO Participatory Learning Action Network and Training Trust (PLANT).

Reef structures are fabricated on the village beach with active fisher participation. A technical team, including SCUBA divers and technology experts, identifies the most suitable deployment sites. Once completed, the structures are deployed on an auspicious day and monitored for six months before being opened for fishing, restricted to hook-and-line and gillnets. To date, PLANT has successfully implemented artificial reef projects in Thirty Six fishing villages and deployed more than 7200 reefs which created fish habitat across Tamil Nadu.

6. Empowering Traditional Fishers

Fishers gain comprehensive knowledge of modern artificial reefs, including fabrication, site selection, deployment, and sustainable fishing practices. This self-sufficiency allows them to construct and manage artificial reefs independently and share their expertise with neighboring fishing communities.

7. Monitoring and Accounting

Once fishing begins, the village committee monitors activities and records catches before marketing them. Revenue is collected, with a small percentage deducted for administrative expenses. These data are crucial for evaluating the economic viability of artificial reefs.

8. Economic Benefits of Artificial Reefs

Data from an artificial reef deployed in Kalpakkam in between 2012 to 2023 in 17 sites revealed that:

- Gillnet units landed an average annual catch of 136.2 tonnes, valued at ₹2.4 Crores and-line fishing, demonstrating significantly higher profitability for hook-and-line fishing.
- The payback period was calculated between 1 to 2 years for each site, making artificial reefs a highly viable investment for fishermen.

9. Ecological Benefits

Artificial reefs introduce structural complexity to barren environments, increasing surface area for benthic organisms. This promotes species diversity and enhances primary production. The study estimated a 23-fold increase in substratum surface area after reef deployment, leading to rapid colonization by marine life such as barnacles, corals, algae, cuttlefish, crabs, and lobsters. These reefs also function as breeding and nursery grounds, supporting marine biodiversity.

10. Social Benefits

Artificial reefs function as community-owned assets, enabling equitable resource sharing among village fishers. They also deter mechanized trawlers from operating in shallow waters, reducing conflicts between traditional and mechanized fishers.

11. Conclusion: Impacts of Artificial Reefs

The deployment of artificial reefs yields multiple ecological, economic, and social benefits, including:

- Enhancement of marine biodiversity through increased habitat complexity.
- Restoration of coastal ecosystems and fishery resources.
- Empowerment of fishermen through participatory institution-building and training.
- Establishment of sustainable fishing practices, improving catch quality and value.
- Reduction in fuel consumption and carbon emissions due to shorter fishing trips.
- Strengthening of fishing communities through cooperative ownership and resource management.
- Regulation of illegal and destructive fishing practices to ensure sustainable resource utilization.

The findings highlight the immense potential of artificial reefs as a low-cost, eco-friendly technology to support marine conservation, fishery resource management, and socio-economic upliftment of traditional fishers in India. Expanding this initiative can lead to widespread benefits for coastal communities and the environment.

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